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ASSESSMENT AND DEVELOPMENT OF NATURAL RESOURCES IN INDIA

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Assessment and Development of Natural Resources in India.

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Natural resources of a country include all the natural aspects of environment on the surface of the earth, in the ground, in the ocean, and in the air. Land, water, plants and animals are basic natural resources which sustain material culture. The atmosphere, and water in its cycles are inexhaustible natural resources. Land includes soil and minerals. Soil provides the base on which the plants including crops, grasses and forests grow, which in their turn support the animals including man. Water is the essential element without which no life is possible. Natural resources supply food, clothing and shelter; fuel for heating and lighting and power and raw materials for industry.

2. Natural resources are classified under two categories; renewable or perpetual, and non-renewable or fugitive. Soil, water, plants and animals are renewable natural resources. If a sound policy of conservation, development and proper utilisation of renewable natural resources is adopted they give us improved and sustained production of crops, grasses, trees, fish, birds and animals. Minerals are generally non-renewable resources which once extracted from the earth serve only once.

3. The wealth of a nation is the skill and energy of its people plus its proved natural resources. In developing the economy of a country the first step is to locate, measure and evaluate the natural resources and the second step is to plan development of these proved resources. A resource does not officially exist till it is discovered, measured and evaluated. Once discovered and evaluated it becomes part of the capital of the nation. Hence survey and assessment of natural resources, viz. land, water, minerals and energy, are necessary preliminary steps to economic development.

4. Planning in India: The stresses and strains of the Second World War underlined the necessity of a planning organisation for the country, and in 1944 the Government of India established a Department of Planning and Development. At the instance of this Department the Central and State Governments prepared a number of development schemes. The Interim Govt. of India, on the advice of an Advisory Planning Board which reviewed problems of planning, recommended the appointment of a Planning Commission in 1946. The Planning Commission was set up by the Government of India in March 1950, and its primary function was to make an assessment of the material, capital and human resources of the country, including technical personnel and to investigate the possibilities of augmenting such of these resources as are found to be deficient in relation to the nation's requirements and to formulate a plan for the most effective and balanced utilisation of the country's resources.

5. The First Five Year Plan(1951-56) was drawn on the basis of information then available on the land, water, mineral and energy resources of the country. The organisations which deal with the survey and utilisation of natural resources are: the Central Water and Power Commission, the Central Board of Irrigation & Power, the Indian Council of Agricultural Resources, the Geological Survey of India, the Oil and Natural Gas Commission, the Indian Bureau of Mines, the Atomic Energy Commission, the Survey of India, Forest Departments of the Central and State Governments, the Botanical Survey of India, and the Council of Scientific and Industrial Research and its National Laboratories. During the Second Five Year Plan (1956-61) these organisations were greatly expanded and they undertook a series of new surveys and investigations which have resulted in a fuller assessment of the country's natural resources bringing to light the gaps relating to these resources and also deficiencies in relation to the nation's future requirements.

The Committee on Natural Resources

6. When the Draft Outline of the Third Five Year Plan was prepared it was felt that a stage has been reached when as a necessary condition of well-conceived long-term plans, a comprehensive view must be taken of the extent and quality of information available regarding natural resources and the further steps needed in relation to specific long-range objectives concerning the development of irrigation, power, steel, coal, oil and minerals, and land and forest resources, and the conservation of natural resources in general. Need was also felt for an appropriate machinery for planning coordinated studies of natural resources on a continuing basis and reviewing the results obtained from time to time and to identify the the gaps in information. Besides, it was realised that the problem of natural resources is a complicated and inter-related problem in which the various Ministries of the Government of India and State Governments are involved apart from the various sectors of the nation, the farmers, industrialists, the producers and the consumers. There is a host of contradictory interests and claimants for natural resources, and each segment of Government looks at the resources from its own angle. In the best interests of the nation a broad view of natural resources has to be taken so that best use is made of them, reconciling contradictory interests and claims. Further, the problems of resource conservation had also to be kept in view, and it was realised that the present generation is the trustee of the past for the good of the future, and natural resources are a national heritage to be shared with the future generations. This problem was particularly brought into the fore by the shortage of raw materials which was experienced particularly of coking coal, which is required for steel-making and which had been used for less important purposes. It was on these considerations that the Committee on Natural Resources was established within the Planning Commission. The main functions of the Committee are:

i) to assess from time to time the available information regarding the natural resources of the country and to identify gaps in it in relation to programmes of planned development;

ii) to arrange for the formulation, in collaboration with the various organisations concerned, of coordinated programmes for survey of natural resources in different parts of the country in relation to plans for long-term economic development;

iii) to initiate studies on problems relating to natural resources and to make recommendations for their conservation, utilisation and development; and

iv) to disseminate information concerning the country's natural resources through publications.

The Committee was constituted under the chairmanship of the Deputy Chairman, Planning Commission it has representatives of the Oil and Natural Gas Commission, the Council of Scientific and Industrial Research, the Indian Council of Agricultural Research, the Geological Survey of India, the Indian Bureau of Mines, the Survey of Indi , the Central Water & Power Commission, the Meteorological Department, and Director, National Council of Applied Economic Research as its members. The Committee was assisted by four Technical Committees on Land, Water, Minerals and Energy.

Natural Resources of India.

In the following account it is proposed very briefly to deal with the natural resources of India, viz. Land, Water, Minerals and Energy.

I. Land

7. Land, which provides the base for agricultural production, is the most important natural resource of the country. Development of communications, rapid urbanisation and growth of cities, irrigation dams and industrial plants, all make large demands on land. The land surface is fixed, and only a certain proportion is available for cultivation.

Land utilisation

8. The total geographical area of India is about 806 million acres, of which reporting area is about 721 million acres and net area sown is about 318 million acres. The broad features of the present pattern of land utilisation and that anticipated by the end of the Third Plan are set out in the table given below.

Availability per head of cultivable land in India is about 0.82 acres as against 0.42 in U.K., 0.48 in Germany, 0.17 in Japan, 0.50 in China, 2.68 in U.S.A., 2.59 in U.S.S.R. and 50.75 in Canada.

Table 1

Land utilisation in 1965-66.

(Area in million acres)

		1955-56	1960-61	1965-66
1.	Total reporting area.	720.0	721.0	721.0
2.	Forests	125.6	131.0	132.0
3.	Land under miscellaneous tree crops and groves.	13.9	14.0	15.0
4.	Permanent pastures and other grazing lands.	28.4	32.0	32.0
5.	Culturable waste.	54.8	47.0	40.0
6.	Barren and uncultivated land and land put to non-agricultural use.	118.7	114.0	114.0
7.	Fallow lands other than current fallows.	30.9	28.0	26.0
8.	Current fallows.	29.5	28.0	25.5
9.	Net area sown.	318.2	327.0	335.0
10.	Area sown more than once.	44.4	51.5	67.0
11.	Gross area sown.	362.6	378.5	402.0

Soil Surveys

9. In 1955 an all-India soil survey scheme was initiated with a view to carrying out reconnaissance soil surveys leading to correlation of soils of different regions. Three years later the scheme was integrated with the scheme for soil and land use planning drawn by the Central Soil Conservation Board for the catchment areas of river valley projects. By the beginning of 1961, an area of about 18,000 square miles had been covered by both detailed and reconnaissance surveys undertaken through the all-India scheme. Of this area, about 3,000 square miles fall within the catchment areas of the river valley projects. Soil surveys organisations in the States have surveyed about 50,000 squar miles. Under the all-India programme, about 23,000 square miles are to be surveyed during the Third Plan.

Survey of waste-lands.

10. Agricultural production can be stepped up through extension of area under cultivation by cultivating waste-lands, double-cropping of single crop areas, and other measures of intensive farming. There is considerable scope for extending the gross area sown by double-cropping. It is anticipated that the area sown more than once might increase from about 52 million acres in 1960-61 to about 67 million acres by 1965-66. According to t the available land utilisation statistics for 1955-56 the area under culturable waste in 1955-56 amounted to about 55 million acres. In June 1959 the Government of India constituted a Committee to make a survey of land classified as "other cultivated land excluding fallow lands" and fallow lands other than current fallows" and to locate areas where large blocks of land are available for reclamation and resettlemtnt. According to the Committee's findings there are nearly a million acres of waste-land in blocks of 250 acres or more.

II Water Resources

11. Water resources may be divided broadly into surface water and ground water. Their development has to be viewed in relation to the need to increase the productivity of land through irrigation, flood control, drainage and other means, as also to meet domestic and industrial requirements.

(a) Surface Water:

12. The annual rainfall over the entire country represents something more than 3000 million acre-feet of water. Of this, about 1700 million acre-feet is lost due to ev aporation and transpiration etc. and roughly 1350 million acre-feet flow into the river systems. Besides the losses due to evaporation and transpiration, there are losses into the subsoil. These however effect the seasonal distribution rather than the annual runoff, as what goes into the soil as ground water at any time reappears to a large extent as regeneration water ultimately. The entire surface flow cannot be utilised because topography, flow characteristics, climate and soil conditions impose limits on usability. It has been estimated that only 450 million acre-feet can be utilised for purposes of irrigation. Progress in actual utilisation for irrigation is as given in the table on the next page.

Table 2.

Surface water utilisation for irrigation

	Million acre-feet.	as per cent of usable flow.	as per cent of total flow
Up to 1951	76	17	6
Upto 1960-61.	120	27	9
Upto 1965-66 (anticipated)	160	36	12

This indicates large scope for irrigation which still exists, and which is the main hope for increased agricultural production for India's growing millions.

(b) Ground water:

13. Open wells for domestic water supply and irrigation have been in use in this country from ages past. The number of open wells in use was estimated at about 5 million at the beginning of the First Five Year Plan(1951-56). It is expected that this number will increase to over 7 million. The number of tube-wells operating for irrigation purposes was over 3,000 at the beginning of the First Five Year Plan. The average discharge from these wells is 20,000 gallons(imperial) per hour. The number of tube-wells at the end of Second Plan(1960-61) was over 10,000 and it is expected that ultimately this may rise to about 40,000. The area under irrigation from ground water sources was about 15 million acres in 1951 and is expected to be about 35 million acres ultimately.

14. Tube-wells have been successfully constructed primarily in the upper reaches of the Indo-Gangetic valley and in certain coastal deltaic areas. Drillings in some of the lower reaches did not yield sufficient water due to high percentage of clay and fine silt in sub-soil strata. In the extreme northern portion, adjoining the foothills of Himalayas, boulder formation prevented drillings being made without the aid of special equipment. For the Third Plan, a project for 300 exploratory bores is in progress. With a view to facilitating the work of exploration and reducing the need for large scale drilling, it is also proposed to carry out geophysical investigations. In peninsular India such investigations would quickly determine the depth of the bed rock and are likely to give first indications of ground water availability. A survey programme is also in hand in Andhra Pradesh in South India for localising areas of ground water availability, where filter points for extraction of water can be successfully drilled.

(c) Optimum utilisation for agriculture:

15. At the beginning of the Second Plan (1955-56), the area irrigated from all sources was 56.2 million acres distributed as shown below:

Table 3

Sources of water	Irrigated area (1955-56) (Million acres)
Government canals	19.8
Private canals	3.4.
Tanks	10.9
Tubewells and other wells.	16.7
Other sources	5.4
Total ..	56.2

16. The irrigation schemes taken up between 1956 and 1966 are expected to add 13.8 and 20 million acres during the Second and Third Plan periods respectively bringing the total to 90 million acres irrigated areas at the end of the Third Plan. As against this, the ultimate potential of all the irrigation schemes(major, medium and minor) that can be taken up in India is estimated to be about 175 million acres. The net area irrigated by major and medium projects at the end of the Second Plan was about 30 million acres.

(d) Public water supply in urban and rural areas:

17. Modern standards of health and cleanliness demand at least 50 gallons of filtered water per head per day. On this basis, the annual requirement would amount to roughly 7 million gallons or 25 million acre-feet. The real problem with public water supply, however, is disparity in distribution - some locations having surplus water and others having very little.

18. In terms of population, protected water supply facilities were created to cater to 18.0 million urban residents upto 1951. During the First and Second Plan periods facilities to cater to an additional 12.0 million urban residents were created. The Third Plan envisages the establishment of facilities to cover another 10.5 million urban residents. Thus the urban population receiving protected water supply benefits in 1966 would be 40.5 million. This would represent 47 % of the total urban population which is placed at 86.0 million.

19. Future work will include analysis of industrial and domestic effluents, data on extent of pollution caused by them, development of methods for their treatment and preparation of standards to which they should conform, before they can be discharged into rivers.

(e) Navigation and Waterways:

20. India is gifted with several river systems like the Ganga, Brahmaputra, Indus, Tapti, Mahanadi, Godavari, Krishna, Cauvery, Narmada etc. However, water transport today thrives only in a few States like West Bengal, Assam, Andhra Pradesh, Bihar and Kerala. The total mileage of Indian waterways at present in use does not exceed 5000, whereas the potential mileage is very high. The Central Water and Power Commission have prepared a rough outline of a "Master Plan" which envisages linking of the Ganga with West flowing rivers to provide continuous waterways from the West Coast (Arabian Sea) to the East Coast (Bay of Bengal), linking the Narmada with Godavari, linking the Tapti with the Godavari system, linking the Ganga with the Mahanadi, and inland coastal waterway from Calcutta to Mangalore via Cuttack and Madras.

(f) Inland fisheries:

21. Rivers and their tributaries, canals, lakes, reservoirs, tanks and ponds with perennial water supply constitute a rich potential source of inland fisheries. Out of 1.4 million tons of annual catch about 300,000 tons are from inland water. In the First Plan over a million acres of inland waters were surveyed and 68,000 acres reclaimed. In the Second Plan about 300,000 acres of inland waters have been surveyed and an area of 720,000 acres stocked. The Third Plan includes proposals for the development of more than 50,000 acres of water area as demonstration fish farms, 1500 acres for estuarine fish culture and about 1500 acres - 2000 acres of marshy and fallow lands reclaimed for fish culture. An urgent need is a

complete survey of waters which do not dry up during summer and which can be stocked with fish. An inventory of the existing waters as to type, namely, ponds, reservoirs, lakes, rivers, etc. and the areas under each type should be prepared. This should be followed by a detailed inventory of the physical, chemical and biological features. When this work is completed, it will provide a sound basis for development of the inland fisheries resources.

(g) Resources of the Sea:

22. India has a coastline of about 3,530 miles, a continental shelf of more than 10,000 square miles and a large number of gulfs and bays along the coast. This alone indicates the vast potentialities of marine resources in the form of marine algae, fish and other edible animals as well as minerals. Oceans are huge reservoirs of organic material and photo-synthesis occurs in them at greater rate than in forest or grassland. The photo-plankton consisting of diatoms and algae which are responsible for the original photo-synthesis are consumed by the fish and other animals. Properly exploited, the productivity of the sea is expected to be equal to that of land.

(i) Marine algae

Marine algae are commonly used as human food in Japan and China. It is a promising source of food which still remains unexploited in India. Sea-weeds are also the source of agar agar, alginates, mucilages and iodine. Some of them can be used for making jams and jellies etc. for human consumption. Addition of sea-weeds to cattle feeds in other countries has proved remarkably beneficial due to the presence of trace elements which the farm animals generally lack. Similarly, incorporation of sea-weed-cowdung compost to soil proved more beneficial to crops than cowdung alone. A preliminary survey conducted by the Central Marine Fisheries Research Station, Mandapam, indicates that systematic exploitation of sea-weeds would be quite profitable. The need of a comprehensive survey of the availability of economic sea-weeds on India's coastline and their utilisation is urgently indicated.

(ii) Marine fish, molluscs and crustaceans:

Out of the total fish production of 1.4 million tons annually about 1.1. million tons are marine. Of the marine fisheries, the most important are the mackerel, sardines and prawns. In 1955-56 India exported Rs.8.4 crores worth of dried and salted fish. India is one of the first seven fishing nations in the world, Japan being the foremost with an annual catch of about 4.8 million tons. India's need is estimated at about 4 million tons but the production rate is less than a quarter of requirements. The sea fisheries generally exploited are confined to 6-10 miles from the coast.

(iii) Minerals from the sea:

Of the mineral resources in the sea, the most important is the common edible salt. Marine salt industry is well established in the sense that the entire quantity of salt required is produced within the country. In 1956-57, India consumed about 3.11 million tons of salt and exported about 0.25 million tons. Production in 1958 was 4.17 million tons valued at about Rs.8.5 crores.

23. At present only a few hundred tons of potassium chloride are recovered from bitterns against a possible total of about 80-90,000 tons, though requirements of potash (K_2O) for agriculture alone is estimated to be about 80,000 tons per year which is expected to rise to about 2,00,000 tons by the end of the Third Plan. Similarly, bromine is recovered to the extent

of 25-30 tons per year against a possible total of several thousand tons. There is great scope for expanding the sea salt industry if the by-products are recovered and utilised either to support indigenous industries or for export. If present techniques on brines become more efficient then in conjunction with large scale desalting of sea-water, it is quite likely that ocean will become the major source for sodium, chlorine and potassium.

(h) Extent of development, priority etc:

24. The development on priority basis of the water resources is being carried out primarily by the Central Water and Power Commission and the Ministry of Food and Agriculture. The Technical Committee on Water of the Natural Resources Committee has taken up studies on (i) surface water, (ii) ground water, (iii) optimum water use for crops and (iv) use of water for domestic and industrial purposes and (v) control of water pollution, in collaboration with the concerned Ministries. These studies will bring out how and to what extent the above water resources may be more intensively utilised.

III ENERGY RESOURCES

25. The demand for energy in India is growing rapidly due to industrialisation, increasing transport facilities and rising standards of living. India's consumption per head is still among the lowest in the world, as is shown below (Table 4):

Table 4

Country	Per capita energy consumption in tons coal equivalent per annum*
U.S.A.	8.6
U.K.	5.0
West Germany	3.6
Netherlands	2.5
Italy	1.1.
Japan	1.1.
India	0.1

*- Energy from non-commercial sources e.g. wood, peat, dung etc. not included and may add up to 0.2 to 0.3 tons coal equivalent for some countries.

It may be assumed that the average for Western Europe - about 2.5 tons per capita - is the minimum essential for an adequate standard of living. Most of the under-developed countries in Asia, Africa and Latin America have a very low per capita energy consumption. Their development necessarily involves greatly enhanced demands for energy.

26. The annual per capita consumption in selected Asian countries is

shown below(Table 5):

Table 5

Country	Total energy in Kilograms of coal equivalent 1959
Afghanistan	20
Burma	50
Ceylon	101
China(People's Republic). ..	498
India	145
Indonesia	135
Iran	202*
Iraq	289*
Japan	965
Korea(Rupublic of)	214
Pakistan	56
Philippines	149
Thailand	67
Vietnam	56

* - figures for 1958

(a) Pattern of production and consumption:

27. The total production of energy in India during 1960-61 was roughly of the order of 165 million tons of coal equivalent. The commercial sources of energy are coal, petroleum and falling water. Wind power and solar, geothermal, tidal and nuclear energy may constitute future sources, subject to appropriate technological developments. Nearly 61 per cent of the energy comes presently from non-commercial sources, such as cattle dung, wood, charcoal, farm wastes, etc. as will be apparent from Table 6 below. Amongst the non-commercial sources of energy, that from animate effort has not been taken into account. This has been estimated to be equivalent to 76 million tons of coal per year.

Table 6

Source	Energy consumed (million tons of coal equivalent)	as per cent of commercial energy.	as per cent of total energy.
Coal	54.60	84.0	33.0
Oil.	9.50	14.6	5.80
Water	0.90.	1.4	0.60
Total-Commercial	65.00	100.00	39.00
Cattle dung	46.00		27.90
Fuel wood	35.00		21.20
Agricultural wastes	19.00		11.50
Total-non-commercial	100.00		60.60
Total-all sources	165.00		100.00

(b) Non-commercial sources of energy:

28. Dried cattle dung is the main source of energy for cooking and heating throughout the rural area and in many urban households as well. It has been estimated that the amount of cattle dung annually available is

1200 million tons(wet weight) of which 400 million tons are used as fuel and 215 million tons as manure, the balance being wasted. On the basis of energy content, 400 million tons of dung is equivalent to 46 million tons of coal. Wood is used as fuel both for domestic purposes as well as by some industries either directly or in the form of charcoal. The fuel-wood consumption of the country is estimated to be of the order of 60 million tons, which in terms of energy equivalent would be equal to roughly 35 million tons of coal.

29. The consumption of 60 million tons of fuel wood would involve an annual deforestation of approximately 30,000 acres of land, assuming an average yield of 2000 tons of wood per acre. The land thus denuded of its cover and binding medium becomes fit only for grazing. In a short time the land becomes impoverished even for grazing and degenerates into desert. Re-afforestation measures, selective fellings and increased production of domestic coke from coal as a substitute for fuel wood would have to be undertaken in order to conserve this valuable resource.

(b) Commercial sources of energy:

(i) Electric power

30. Large quantities of low grade coal and middlings will be available at collieries and washeries for generation of power. These locations are, therefore, well suited for coal-fired stations. Hydel stations take a long time to set up, involve relatively larger outlays and are, by their very nature, located in relatively remote localities from which the power has to be transmitted over long distances. These are, however, the cheapest source of power. The break-up of generating capacity among different types of plants is indicated below(Table 7):

Table 7

(million kilowatts)

	1951	1956	1961	1966
Hydel Plant	0.56	0.94	1.85	5.07
Coal	1.59	2.27	3.40	7.13
Oil	0.15	0.21	0.34	0.39
Gas	-	-	-	0.07
Total ..	2.30	3.42	5.59	12.66

31. Currently, the electric energy consumption in India is about 45 kwh per head of population. In 1950, it was 14 and in 1958, 35 kwh and by 1965-66 this is expected to increase to about 95 kwh per capita. This rate of increase will need to be maintained for a long period. Compared to other countries India's consumption is extremely low. In Japan per capita consumption rose from 455 kwh in 1947 to 930 in 1958; in Italy during the same period it rose from 454 kwh to 928.

(ii) Water power:

32. The potential of water power has been generally estimated to be about

41 million kw distributed as shown below (Table 8):

Table 8

		(million kw) @ 60% load factor
West flowing South Indian rivers.	..	4.35
East flowing South Indian rivers.	..	8.63
Central Indian rivers.	..	4.29
Rivers of Ganga basin.	..	4.83
Rivers of Indus basin.	..	6.58
Brahmaputra and others.	..	12.49
Total	..	41.17

33. Extensive surveys of individual project sites involving contouring, reservoir areas, flow characteristics, availability of local construction materials, etc., have to be undertaken before this potential can be more definitely assessed and harnessed. In the Third Plan 64 specific project sites are proposed to be investigated.

(iii) Nuclear Energy:

34. For a self-sufficient atomic energy programme an adequate supply of fuel material is a pre-requisite. It has been known for several decades that in the monazite sands from the beaches of the Kerala and Madras coasts India has one of the largest deposits of thorium in the world, containing no less than 200,000 tons of thorium in a concentration of over 9%. As a result of the work of the Atomic Minerals Division, during the period of the Second Plan an even more extensive monazite deposit has been discovered in the State of Bihar which contains about 300,000 tons of thorium in a concentration of over 10%. India thus has the largest known thorium reserves in the world equalling in amount the total world reserve of uranium. Several deposits of urnaium also have been discovered in various parts of the country, which are still being proved by drilling. A deposit containing several thousand tons of uranium has been established in Bihar and steps are being taken to open a mine to produce a thousand tons of ore a day. Nuclear power plants are expected to make a progressive contribution towards meeting the growing demand for power particularly in areas which are far away from coal-fields.

(c) Unconventional sources of energy:

35. Attempts to convert primary forms of energy such as solar radiation, wind motion, tidal energy, heat of the earth and oceans etc. are being made in different parts of the world. Of the several devices developed so far, solar house heating, solar batteries and wind power generators have proved reasonably successful in many places. Tidal motion has also been harnessed in some countries.

36. In India, work has been done on the development of a solar cooker, a solar evaporator and prototype windmills. A great deal of research and experimentation and several years of development work go into every device meant for catching the energy of the sun, wind or tides in an efficient and economical manner. Research schemes for tapping unconventional sources of

energy should be launched.

37. In India, a preliminary survey of wind velocities has been carried out and suitable regions favourable for utilisation of wind power have been located. It is proposed to instal shortly 200 wind mills at selected localities on an experimental basis. These mills will be made according to a design developed in India and used essentially for pumping water. Investigations are also being carried out for the development of a suitable design for small scale electricity generation. There is also a project in view for the utilisation of solar energy for dehumidification of factories.

(d) Extent of development, priority, etc.

38. The Technical Committee on Energy of the Natural Resources Committee of the Planning Commission has made programme for studies on the following items in respect of energy resources in India on a priority basis in collaboration with the concerned Ministries, Atomic Energy Commission and the concerned National Laboratories:

(i) Coal, Lignite and Coal gas.
(ii) Oil and Natural Gas.
(iii) Hydro Resources.
(iv) Atomic Energy.
(v) Fuel problems of villages.

IV. MINERAL RESOURCES

39. India has fairly abundant reserves (in terms of volume) of coal, iron ore and mica, adequate supplies of ores of manganese, titanium and aluminium, raw materials for refractories and limestone, but there is dificiency in ores of copper lead and zinc. There are no workable deposits of tin, nickel, molybdenum and elemental sulphur. Until recently, except for Digboi in Assam mineral oil was not known to occur in other parts of the country.

(a) Coal:

40. Coal is India's most important mineral asset and is the main source of commercial energy. Reserves of coal in seams of 4 ft. and over in thickness and occurring within a depth of about 2000 ft. are estimated to be of the order of 43,000 million tons. Inferred reserves are placed at an additional 80,000 million tons, i.e. the total reserves of coal proved, estimated and inferred thus comes to about 123,000 million tons. In addition, about 2000 million tons of lignite are also estimated to be available. The country's reserves of coal from about 1/50th of the total estimated world reserves, whereas the country's population is about 14 % of the total estimated world population. As a result of planned economic development, output of coal has increased rapidly in the recent past.

41. Thougn in terms of quantity the reserves appear to be large, the fact that the major portion of the reserves are of a poor quality, is a matter of serious concern. This is all the more so in the case of coking coal, the reserves of which are very small -- only about 2,800 million tons -- and it is particularly significant when viewed in the context of the fairly widespread and large reserves of good quality iron ore available in the country. The rapid increase in the output of steel visualised in the next 15 years will increase the demand for coking coal. The situation, therefore, calls for focussing attention on measures of conservation such as washing & blending, for economy in the consumption of coking coal and to investigating the possibility of producing iron and steel using non-coking coal. The position in regard to non-coking coal is satisfactory, but since the bulk of the reserves are of low grade, economy in the consumption of better grade

coal is essential.

42. Unlike in the U.S.A., U.K. and the Continent of Europe, where the ash in coal occurs segregated in layers making washing comparatively easy and cheap, Indian coals are fairly difficult to wash because the ash is uniformly distributed in the coal substance. In the process of washing Indian coals, therefore, a sizeable proportion of the coal substance gets removed along with the ash to form middlings, the proportion of which depends upon the quality of the raw coal input and the quality desired in the clean coal. The main problem facing the washeries, therefore, is one of finding a profitable outlet for the middlings produced. Such an outlet will improve the economics of washing and at the same time find a solution for the problem of disposal of middlings.

43. Yet another problem facing the coal industry is finding a market for the slack coal produced. Large thermal power stations located near washeries or in the coal-fields would be able to utilise washery middlings or slack coal. Complete gasification of slack coal or low grade non-coking coal would besides finding a use for these types of coal, also meet the ever increasing demand for domestic fuel. Similarly, low temperature carbonisation of slack coal would also provide a convenient source of domestic fuel. These measures would, besides meeting the demand for domestic fuel, help in releasing cowdung which can be more profitably used as a manure and also reduce the pressure on supplies of fuel wood and charcoal and thereby reduce deforestation and the attendant soil erosion.

(b) Mineral Oil and Natural Gas:

44. Next to coal, petroleum and natural gas are major sources of commercial energy. Until recently India had not developed any considerable domestic supplies of petroleum. However, intensive exploration during the last few years has established sizeable reserves of mineral oil in Assam, the exploitation of which has been taken up. The programme envisages an annual production of 2.75 million tons of oil and if additional reserves are proved, it would be possible to step up the production proportionately in the course of the Third Plan or early in the Fourth Plan period.

45. Besides mineral oil, natural gas, both associated and non-associated, has also been proved in Assam. Plans have been made for utilising the associated natural gas for the manufacture of fertilisers, for thermal power generation and as a source of domestic and industrial fuel.

46. Recent drilling operations in Cambay and Ankleshwar areas in Gujarat indicate a sizeable oilfield in that region and on the basis of the data obtained, plans have been prepared for exploiting the oilfind for an annual production of about 2 million tons to be achieved by 1965-66 and for its refining in a new refinery located in the region.

47. The annual increase in the demand for petroleum products which was 4-5 per cent during the last decade is expected to rise to 10-11 per cent in the current decades. The total demand which was about 7.5 million tons in 1960 is expected to rise to over 11 million tons in 1965-66. Household requirements (chiefly kerosene for lighting) represent about 25 per cent of the total consumption. The demand of the transport sector (diesel oil and gasolene) is more than 30 per cent. The share of industry is about 20 per cent, mainly in the form of furnace oil. There has been a significant increase in the consumption of middle distillates, comprising kerosene and diesel oil. The main problem is one of imbalance between production of middle distillates which cannot be varied except within limits and the

economy's requirements of middle distillates. Measures for the solution of this problem are receiving attention.

(c) Iron ore:

48. The assessment of mineral resources of the country with a view to making a quantitative and qualitative assessment of these reserves is an important task which the country has embarked upon. A recent survey of the world iron ore reserves by a Committee of U.N.Experts in 1955 has shown that India, Brazil, U.S.A. and U.S.S.R. have large reserves of this mineral and that on present indications, India comes first. Out of a total estimated world reserve of 85,000 million tons, India is estimated to have 21,000 million tons, of which 17,000 million tons are hematite, 1600 million tons magnesite and 2000 million tons siderite.

(d) Lime-stone

49. There are abundant reserves of limestone, the qualitative assessment of which, particularly from the point of view of steel plants' requirements is a matter of urgent priority. Reserves of bauxite, magnesite and gypsum are adequate to meet the country's requirements.

(e) Other minerals:

50. In regard to copper ore, lead and zinc ores, the present data shows fairly wide gap between the resources available and the requirements thereof. An intensive survey for locating fresh deposits of these metals and for assessing more accurately the reserves in occurrences already known or reported is an item of great priority. Proving of a large reserve of pyrites in Amjor area(Bihar) and the availability of pyrites associated with the copper ores in Khetri(Rajasthan), opens up the prospect of meeting a substantial part of the demand for sulphur from internal sources.

CONCLUSION

The review which we have given of the natural resources of India indicates that there is a large potential for agricultural development and industrial production. It holds out a promise of a self-reliant and self-sustained economy which could provide to the masses of the people a continually rising standard of living and more opportunities for gainful employment.

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